Brain Gate Technology

Bhavani V.R & Priyanka .V
TRP Engineering College
Tamilnadu, India

Shanmugasundaram Hariharan
TRP Engineering College
Tamilnadu, India

Abstract **- Thousands of people around the world suffer from paralysis, rendering them dependent on others to perform even the most basic tasks. But that could change, thanks to the latest achievements in the field of BrainGate technology, which could help them regain a portion of their lost independence. The mind-to-movement system that allows a quadriplegic man to control a computer using only his thoughts is a scientific milestone .It was reached, in large part through the braingate system. Brain gate neural interface system is based on ‚Cyber kinetics platform technology to sense, transmits, analyze and apply the language of neurons. Scientists are to implant tiny computer chips in the brains of paralyzed patients which could 'read their thoughts' It would be a huge therapeutic application for people who have seizures, which leads to the idea of a 'pacemaker for the brain'.**

Keywords— Cyber Kinetics; Brain Computer Interface; Neural Interface

I. INTRODUCTION

BrainGate is a brain implant system developed by the bio-tech company, Cyber kinetics in conjunction with the Department of Neuroscience at Brown University. The development of the braingate system brain-computer interface is to enable those with severe paralysis and other neurological conditions to live more productively and independently. The computer chip, which is implanted into the brain, monitors brain activity in the patient and converts the intention of the user into computer commands. Currently the chipuses about 100 hair-thin electrodes that sense the electro-magnetic signature of neurons firing in specific areas of the brain. The activity is translated into electrically charged signals and is then sent and decoded using a program, which can move a robotic arm, a computer cursor, or even a wheelchair. Scientists are developing the brain gate systems underlying core technology in the neuroport system to enable improved diagnosis and treatment for a number of neurological conditions, such as epilepsy and brain trauma. Brain gate will be the first human device that has been designed to record, filter, and amplify multiple channels of simultaneously recorded neural activity at a very high spatial and temporal resolution. When a person becomes paralyzed, neural signal from the brain no longer reach their designated site of termination. However, the brain continues to send out these signals although they do not reach their destination. It is these signals that the brain gate system picks up and they must be present in order for the system to work. It is found that people with long-standing, severe paralysis can generate signals in the area of the brain responsible for voluntary movement and these signals can be detected, recorded, routed out of the brain to a computer and converted into actions enabling a paralyzed patient to perform basic tasks. Scientists are to implant tiny computer chips in the brains of paralyzed patients which could 'read their thoughts'. Brain gate consists of a surgically implanted sensor that records the activity of dozens of brain cells simultaneously. The system also decodes these signals in real time to control a computer or other external devices. The brain gate technology platform was designed to take advantage of the fact that many patients with motor impairment have an intact brain that can produce movement commands allowing the brain gate system to create an output signal directly from the brain, bypassing the route through the nerves to the muscles that cannot be used in paralyzed people.

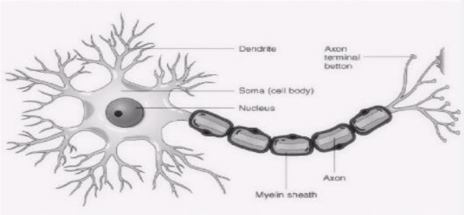

Fig. 1. Neural Activity

Figure 1 presents the signals sent through dendrites causing chemical changes that result in an Electrical signal in the cell body. Axons denote the nerve impulses are carried through axons away from the neurons cell body. A neuron muscular junction is the signal is passed by neuron transmitters from synaptic bulbs on the neurons to muscle fibers. The muscle fibers then react to the signal.

II. WORKING

The basic elements of BrainGate are:

- The chip: A four-millimeter square silicon chip studded with about 100 hair-thin microelectrodes is embedded in the primary motor cortex-the region of the brain responsible for controlling movement.
  - The connector: When somebody thinks ‚move cursor up and left his cortical neurons fire in a distinctive pattern the signal is transmitted through the pedestal plug attached to the skull.

- The converter: The signal travels to an amplifier where it is converted to optical data and bounced by fiber optic cable to a computer.
- The computer: Brain gate learns to associate patterns of brain activity with particular imagined movements up, down, left, right and to connect those movements to a cursor.

A. Brains behind BrainGate

The person thinks of moving the computer cursor. Electrodes on the silicon chip implanted into the persons brain detect neural activity from an array of neural impulses in the brains motor cortex. The impulses transfer from the chip to a pedestal protruding from the scalp through connection wires. The pedestal, filters out unwanted signals or noise, and then transfers the signal to an amplifier. The signal is captured by acquisition system and is sent through a fiber optic cable to a computer. The computer then translates the signal into an action, causing the cursor to move. The brain gate system is a neuromotor prosthetic device consisting of an array of one hundred silicon micro-electrodes; each electrode is 1mm long and thinner than a human hair. The electrodes are arranged less than half a millimetre apart on the array, which is attached to a 13cm-long cable ribbon cable connecting it to a computer. The BrainGate neural interface system is a proprietary, investigational Brain-Computer Interface(BCI) that consists of an internal sensor to detect brain cell activity and external processors that convert these brain signals into a computer-mediated output under the person’s own control. The sensor is implanted on the surface of the area of the brain responsible for voluntary movement, the motor cortex. The electrodes penetrate about 1 mm into the surface of the brain where they pick up electrical signals known as neural spiking, the language of the brain from nearby neurons and transmit them through thin gold wires to a titanium pedestal that protrudes about an inch above the patient’s scalp. An external cable connects the pedestal to computers, signal processors and monitors. The technology is able to sense the electrical activity of many individual neurons at one time the data is transmitted fro the neurons in the brain to computers where it is analyzed and the thoughts are used to control an external device. even 20 and 200 times a second and they work in teams. The reason a BCI works at all is because of the way our brains function. Our brains are filled with neurons, individual nerve cells connected to one another by dendrites and axons. Every time we think, move, feel or remember something, our neurons are at work. That work is carried out by small electric signals that zip from neuron to neuron as fast as 250 mph .The signals are generated by differences in electric potential carried by ions on the membrane of each neuron.

Although the paths the signals take are insulated by something called myelin, some of the electric signal escapes. Scientists can detect those signals, interpret what they mean and use them to direct a device of some kind. It can also work the other way around. For example, researchers could figure out what signals are sent to the brain by the optic nerve when someone sees the color red. They could rig a camera that would send those exact signals into someone’s brain whenever the camera saw red, allowing a blind person to “see” without eyes.

III. RELATED WORK

BrainGate can remain safely implanted in the brain for at least two years. Spiking from many neurons the language of the brain can be recorded, routed outside the human brain and decoded into command signals. Paralyzed humans can directly and successfully control external devices such as a computer cursor using these neural command signals. The speed, accuracy and precision are comparable to a non-disabled person there is no training necessary

IV. PROPOSED WORK

The brain gate neural interface system is an investigational medical device that is being developed to improve the quality of life for physically disabled people by allowing them to quickly and reliably control a wide range of devices by thought including computers, environment controls, robotics and medical devices. One of the most exciting areas of BCI research is the development of devices that can be controlled by thoughts. Some of the application of this technology may seem frivolous such as the ability to control a video game by thought. Cyber Kinetics is also developing products to allow for robotic control, such as a thought-controlled wheelchair. Next generation products may be able to provide an individual with the ability to control devices that allow breathing, bladder and bowel movements. The Bain gate system has allowed people with paralysis to operate a computer in order to read e-mail, control a wheel chair and operate a robotic hand. The device can be used in an interactive environment. Activity surrounding the patients will not affect the accuracy of the device.

V. CONCLUSION

The technology driving this breakthrough in the Brain-Machine-Interface field has a myriad of potential applications, including the development of human augmentation for military and commercial purposes .The primary goal of this technology and devices like brain gate is to help those are who are paralyzed to perform routine activities that are part of normal human existence. The brain gate can be used to replace the ,memory centre in patients affected by strokes,epilepsy or Alzheimers disease.The ‘BrainGate’ device can provide paralysed or Motor-impaired patients a mode of communication through the translation of thought into direct computer control. Normal humans may also be able to utilize BrainGate technology to enhance their relationship with the digital world provided they are willing to receive the implant.

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